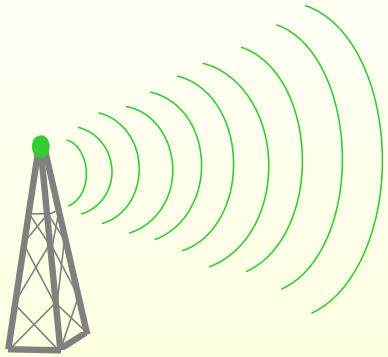
CSX TRANSPORTATION



C B T M

Communications Based Train Management

October 23, 2002

CBTM Status

- CSX has entered into a service agreement with Wabtec, to keep CBTM working as a pilot system
- Full-time Field Service Engineer in Spartanburg
  - Responsible for monitoring and troubleshooting locomotives and wayside equipment
  - Represents CBTM to CSX personnel
- Data Gathering
  - Evaluate performance
  - Determine requirements for a production system
- Crew acceptance continues to be positive
  - Issues with braking algorithm

CBTM Performance

- **Safety Enforcements**
  - Failed to hear audible warning
  - Warning time to enforcement not sufficient
  - Use of default consist
- **System Issues**
  - Communications: coverage; on-board radios
  - CADS Interface: downtime; database corruption
- **2001 Performance Improvements**
  - Retain track database on-board
    - Speeds up initialization process and reduces communication
  - Upgrade of the VHF Radio software
    - Increases the performance and reliability of the RF communications

CBTM Business Case

- **Rail Sciences, Inc (RSI) completed an economic evaluation of CBTM in July, 2001**
- **RSI concluded that:**
  - **of all the existing or planned PTC installations, CBTM has the strongest cost justification;**
  - **CBTM minimizes the technical risk, which lowers its delivered cost;**
  - **in addition to safety, CBTM provides significant operational and cost reduction benefits relative to its cost**

CBTM Drivers

- **CBTM can drive improvements in:**
  - **Safety**
    - Prevention of collisions, enforcement of speed limits and protection of work authorities
  - **Operational Benefits**
    - Reduced operating delays
    - Increased velocity due to more efficient meets and passes
    - Time savings for dispatchers and crews
    - Capital avoidance
  - **Signal System Retirement**
    - Elimination of TCS from low-density lines resulting in avoided maintenance costs
  - **Process Changes**
    - Issuance and release of movement authorities

CBTM Revised Cost Estimate

- **Wabtec completed a detailed cost analysis in May 2002**
  - **Revised cost estimate is based on their efforts to develop:**
    - **production hardware and software for CBTM;**
    - **the onboard platform for the the IDOT Project**
- **Cost comparison:**

	July 2001	August 2002
– One Time Implementation:	$351.9M*	$199.0M
• 2.7K Locomotives ($15K vs. $24.4K each)		
• ~15.0K Miles of Track ($20K vs. $8.3K per mile)		
• 5% Contingency		
– Recurring Annual Cost	$1.8M	$10.9M*

*** - includes training**

CBTM Potential Benefits

- **RSI updated their economic evaluation of CBTM based on the revised cost estimate**
- **CBTM Economic Evaluation showed an increase in the ROI from hard benefits from 18% to 30%**
  - **(velocity, safety, avoided maintenance costs and capital investments)**
  - **ROI from hard benefits on selected subdivisions is even higher**

2002 CBTM Enhancements

- **Display replacement**
  - **Replace current monochrome display with a full color, integrated display**
- **Digital Display of Authorities**
  - **Allows the dispatcher to issue and extend authority digitally, without verbally contacting the crew**
  - **Allows the crew to view and release movement authorities digitally from the locomotive cab**

2002 CBTM Enhancements

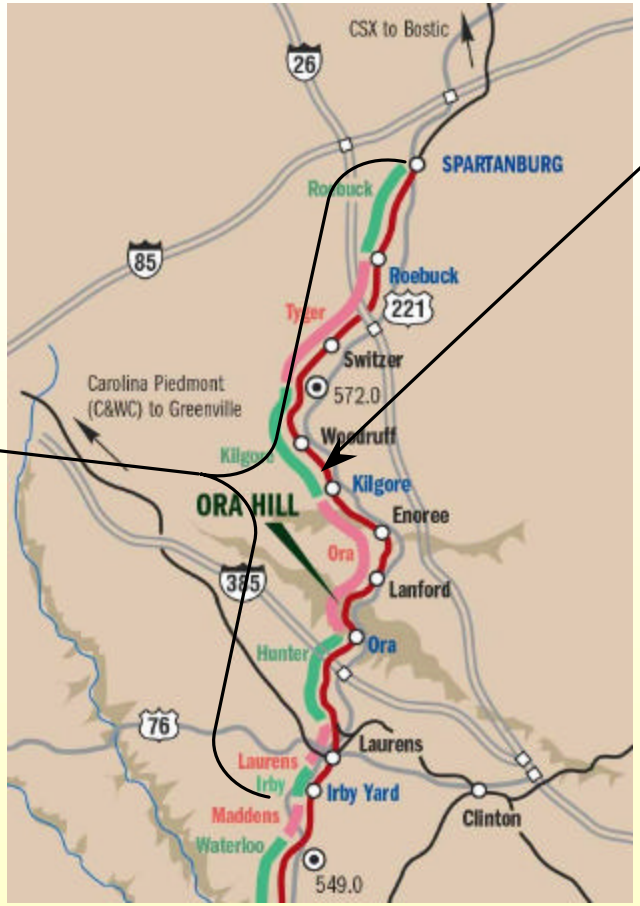
- **Locally Controlled Power Switches are operated by the crew from the cab of a locomotive**
  - **Design has utilized alternative methods to satisfy the requirements for signals, which are typically associated with power switch installations**
- **Benefits:**
  - **Eliminates the need for crews to physically throw the switch**
  - **Reduces the time required during meets**
  - **Increases average train velocity**
  - **Reduces the risk of crew injury**

2002 CBTM Communications Enhancement

- **Install a UHF ATCS network on approximately 50 miles of the current CBTM territory to operate in parallel with existing VHF infrastructure**
  - **Allows CBTM to be designed, developed and tested using the ATCS Spec 200 protocol**
    - **CBTM can then leverage the infrastructure already installed for radio code lines**
  - **Installation in non-signaled territory to support CBTM enables other applications to become less dependent on commercial services**

ATCS Additions

- CSXT track in pilot territory
- Current pilot is VHF
- Add UHF ATCS Spec 200 data network between Spartanburg and Irby



- Powered switch installations at both ends of Kilgore siding

2002 CBTM Enhancements

- **Wabtec is providing matching funds to address system reliability by migrating CBTM to a production ready platform**

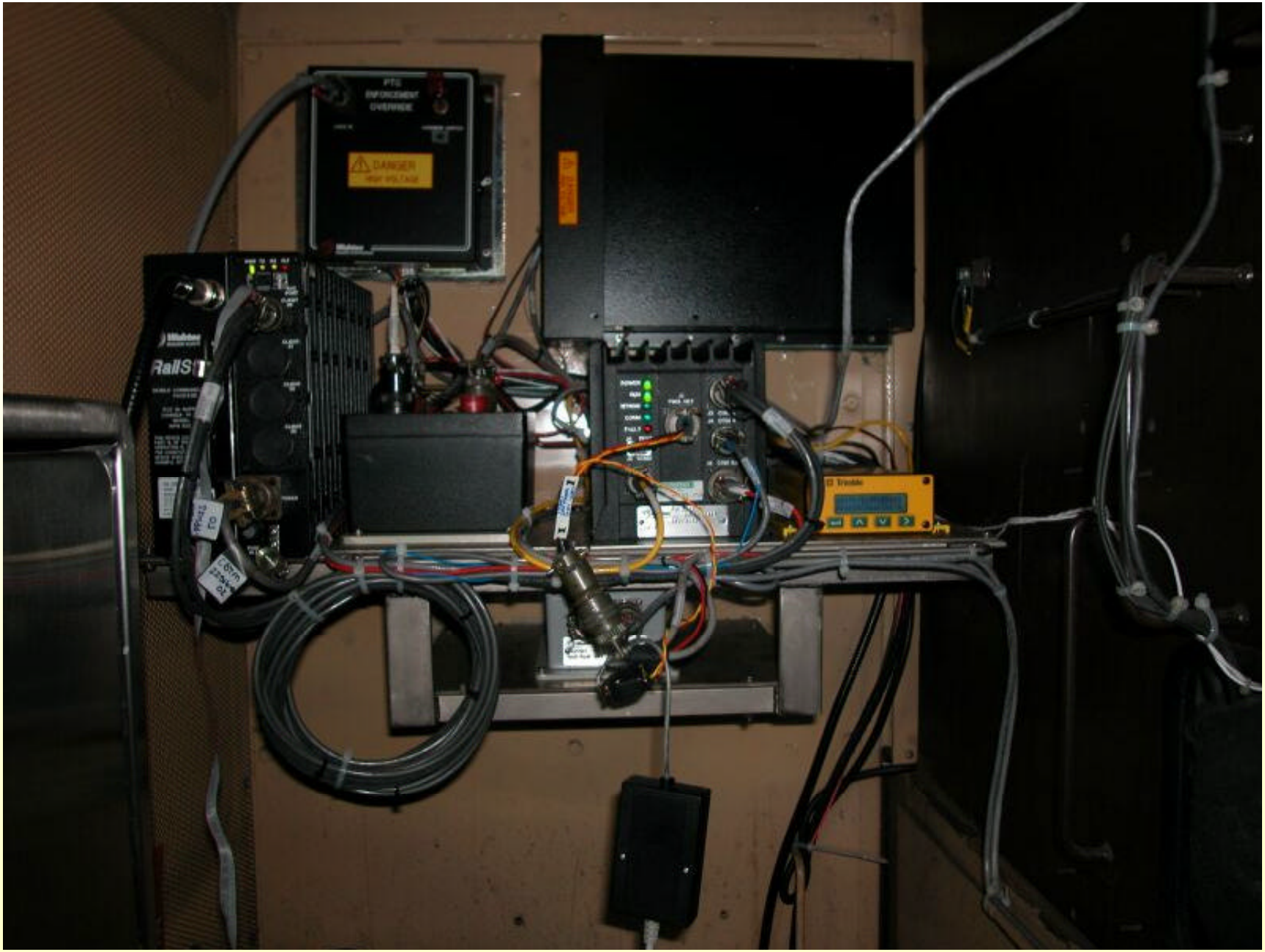
Goal is to demonstrate benefits outlined in business case

Production Ready On-Board Platform

- Required to support locally controlled power switches and digital display of authority
- Improved maintainability and reliability
- Development includes:
  - Hardware
    - Display
    - Processor
    - Locomotive interface
    - Data radio
  - Software development
    - Lessons learned
    - Additional features

Hardware Changes

- Replace TransitMaster display with New Display
- Supplement IFC / Event Recorder interface with IFC / Electronic Air Brake interface
- Replace RDR-160 with MCP
- Replace “Pizza Box” with On-Board Processor
- Separate Locomotive ID module
- Replace brake interface relay with brake interface module
- Replace Sonalert ™
- Replace power supply
- GPS Receiver and Antenna – Potential Replacement


PTC
ENFORCEMENT
OVERRIDE
DANGER
HIGH VOLTAGE
RailSt
Trimble

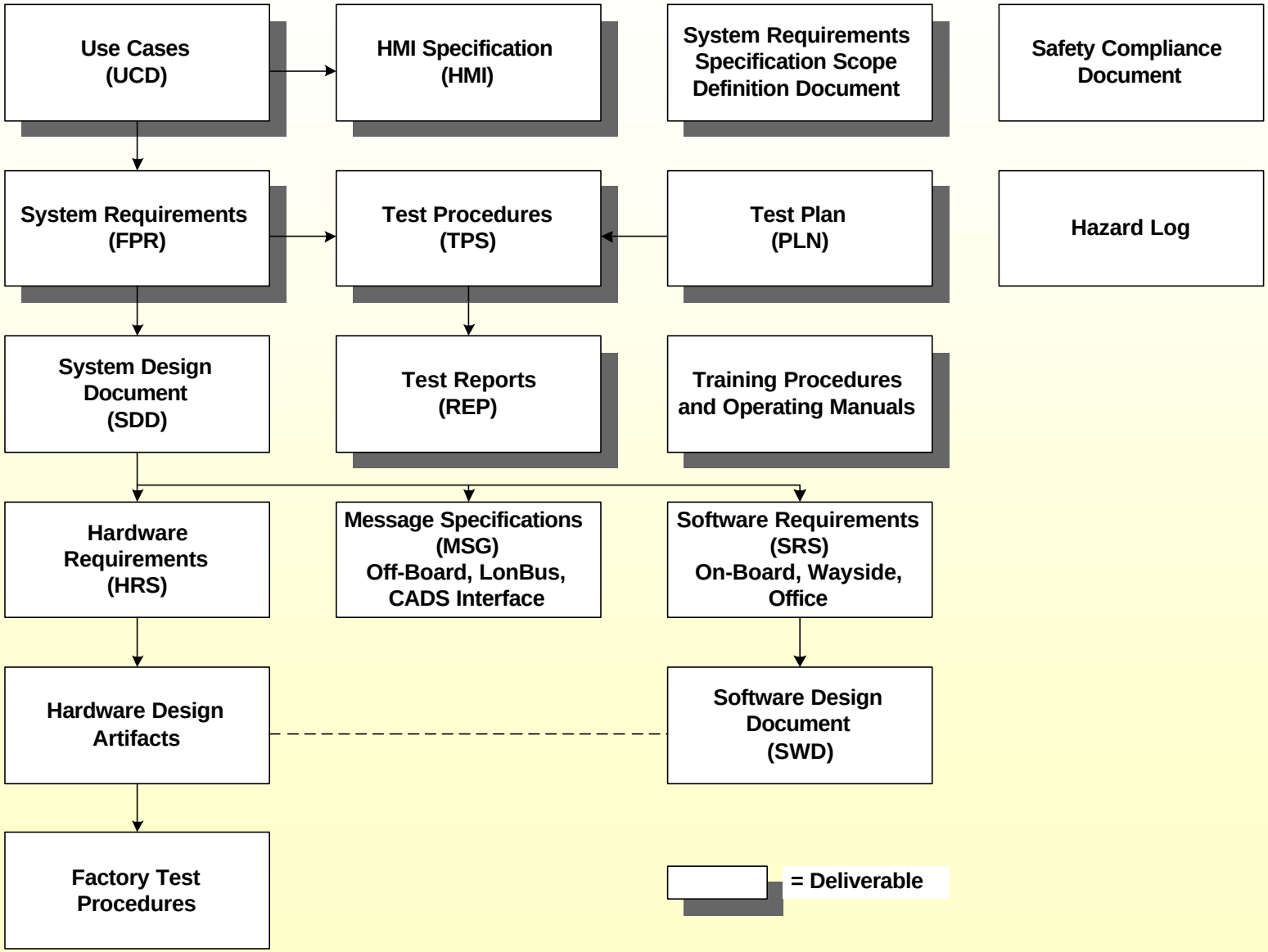
On-Board Platform Safety Considerations

- On-board platform activity is:
  - Re-hosting existing system on new hardware
  - Re-partitioning software objects
  - Re-implementing existing functions
- This is not a fundamental change in CBTM system, scope or functionality
- The new on-board platform does not require safety activity beyond that performed for the pilot
- Additional safety activities will take place for Power Switch and DDA, since these are beyond the scope of the original system

System Design Process

- **Requirements**
  - Reflect lessons learned from CBTM pilot and Eastern Project
  - Address CSXT issues list
  - Incorporate new features and previous functional specification efforts
  - Produce documents useful to the development team, no paper for paper's sake
  - Retain applicable documentation from pilot project
- **Design**
  - Support production ready on-board platform
  - Simplify architecture
  - Allow for the addition of new functionally
- **Development**
  - Phased approach
  - Incremental verification (following Wabtec standards)
- **Test**
  - Utilize both lab and field testing

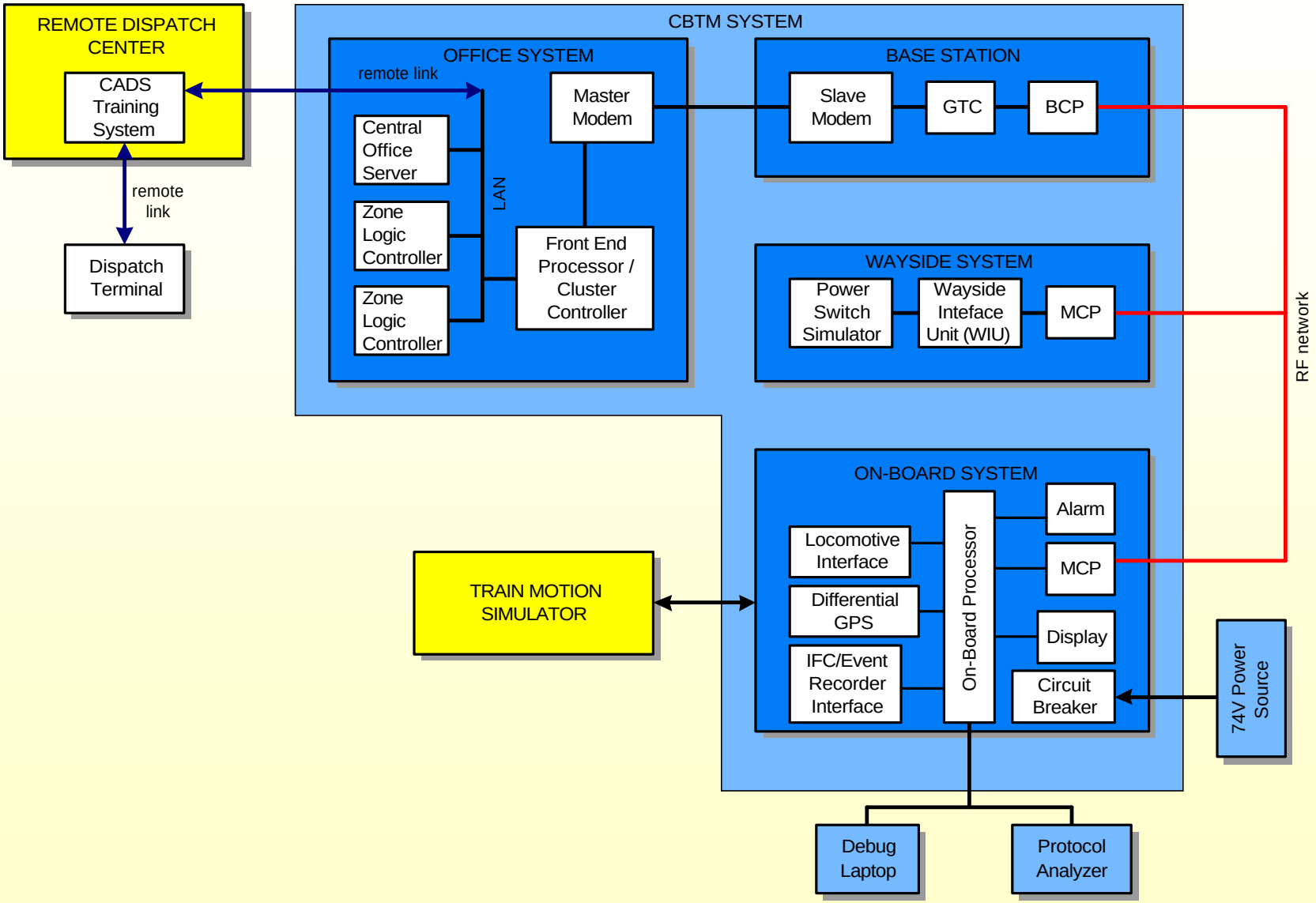
Document Tree



Test Strategy

- Evaluate system against the functionality described in the System Requirements Specification
- Two overall types of tests
  - Lab tests
    - Demonstrate conformance with system requirements
  - Field tests
    - Perform a subset of lab tests modified for field environment
    - Demonstrate elements that can't be tested in the lab
      - Communication via actual data network
      - System interface with an actual locomotive
      - Speed and location accuracy
      - Stopping distance accuracy

Lab Test Environment



Safety Summary

- CBTM Program is following the safety process outlined in the NPRM
  - Define hazards
  - Demonstrate mitigation
  - Peer review
  - Trace requirements through test
- Not creating Product Safety Plan (PSP) at this time
- Producing a Safety Compliance Document
  - Documents the performance of this safety process
  - Demonstrates prudent efforts have been taken to ensure safety of the system
  - Contain portions of PSP as defined in NPRM
- Can build a PSP later